CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

FERTILITY AND MANAGEMENT STUDIES ON GRAY WOODED SOILS

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PROGRESS REPORT
1927 - 1956

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Foreword

The material in this report is derived from experimental work conducted by Illustration Stations Research Officers on special stations for gray wooded soils investigations. These special stations are located in districts served by the Experimental Farms at Melfort and Scott in Saskatchewan, and Lacombe and Beaverlodge in Alberta. This report has been prepared by the Illustration Stations Division staff at Ottawa in consultation with the Soil Survey and Soil Fertility Sections of the Field Husbandry, Soils and Agricultural Engineering Division.

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Introduction

The Gray Wooded soil zone covers the major part of the undeveloped areas of Saskatchewan and Alberta. Altogether its area is well over 100 million acres. The gray wooded soils occur naturally under a forest cover of poplar, spruce, and in some areas pine. Climatic conditions are continental sub-humid and microthermal.

The gray wooded soils of Western Canada in the virgin state are characterized by an A_0 horizon, a thick, light colored A_2 horizon, and a brown to gray-brown heavy textured B-horizon. The C horizon, as well as the lower B horizon, is usually calcareous. The A_1 horizon, if present, is usually very thin. Under cultivation, these soil areas are characterized by a light gray or pale brown color of the surface soil. This is the result of the layer turned up by the plow consisting largely of the A_2 horizon.

Only a limited amount of agricultural development has taken place to date in this soil zone. This is due largely to the cost of clearing and breaking the land and to the relatively low fertility of the soil, which is less than that of gray-black and black soils.

This low fertility was recognized as a major problem in the early days of experimental studies on gray wooded soils. It was observed that there were areas where crops would not grow well even when moisture was ample. The Rocky Mountain House region of Alberta was such an area and in 1927 an Illustration Station was established in it near Chedderville, Alberta, a district known locally as "Starvation Ridge", because farmers were unable to make a living as crops would not grow. However, within a few years after the establishment of the station it was found that the application of sulphur had a marked effect on plant growth and good yields of forages and cereals could be obtained through its use. The work expanded with the establishment of additional Illustration Stations and other experimental units. The salient results of experimental work conducted on these stations and at other selected locations in Alberta and Saskatchewan are presented and discussed in this report.

Soil Types

The data summarized in this report were obtained at the following locations and on the specific soil types listed for each, as follows:

Athabasca, Alta.	unclassified
Chedderville, Alta.	Caroline Loam
McLennan, Alta.	Nampa Clay Loam
Dorintosh, Sask.	Dorintosh Loam
Glaslyn, Sask.	Waitville Loam
Loon Lake, Sask.	Loon River Loam
Snowden, Sask.	Garrick Loam

These soil types are described in some detail in Alberta and Saskatchewan soil survey reports covering the locations mentioned above. However, brief mention here of the major characteristics of these soils may aid in interpreting the results discussed.

The Caroline and Dorintosh soils have developed on stone-free, silty, lacustrine deposits. These soils have relatively thick A_2 and B horizons, are permeable, and present no physical problems to plant growth except for surface crusting. The Caroline contains somewhat less clay, particularly in the subsoil; is more acidic in the A and B horizons; and is probably lower in natural fertility than the Dorintosh.

The Nampa and Garrick soils were developed on lacustrine clay deposits. The Nampa soil is characterized by a tough clay subsoil which is only slowly permeable; thus restricting root development, water and air movement. The Garrick has a considerably more permeable clay subsoil. Gypsum is present in the lower zones of root development in both these soils.

The Loon River and Waitville soils have developed on glacial till slightly to moderately stony. The parent material of the Loon River soil occurs at a somewhat greater depth than the Waitville parent material, the latter having a higher lime content. Root development is more restricted in the Loon River soil as its subsoil is usually tougher and more compact than the subsoil of the Waitville.

The work at Athabasca has been done largely on a mixed association of soils which, while not uniformly gray wooded, do represent a considerable area now under cultivation. Only one study was conducted on clearly gray wooded soil and the results are presented.

Regional Precipitation

Daily precipitation records are maintained at five stations. The average monthly and total precipitation data for four stations are presented in Table 1. At Dorintosh, the 1952–54 average annual precipitation varied from 14.5 to 20.0 inches. At Loon Lake, the range was from a low of 14.1 inches for the 1949-54 period to a high of 21.8 inches. At McLennan, precipitation varied from 15.8 to 18.5 inches. The range in precipitation at Snowden was from 12.7 inches up to 22.1 inches during the 13-year period averaged. The eight-year average precipitation at Athabasca was 19.5 inches. The yearly variability is indicated by the fact that there was 29.1 inches of precipitation at Athabasca in 1955.

Table 1.—Average Monthly Precipitation at Four Stations

Month	Dorintosh 3-year av. 1952–54	Loon Lake 6-year av. 1949–54	McLennan 4-year av. 1951–54	Snowden 13-year av. 1942–54
	in.	in.	in.	in.
January	0.68	0.72	1.71	0.76
February	0.22	0.30	0.89	0.71
March	0.57	0.81	0.75	0.69
April	0.43	0.49	0.42	0.85
May	1.45	1.52	2.14	1.53
June	2.63	2.68	2.67	2.71
July	4.17	4.20	3.22	2.62
August	4.15	2.93	2.36	2.37
September	1.66	1.80	1.01	1.31
October	0.43	0.79	0.68	0.97
November	0.60	0.73	0.51	1.00
December	0.50	0.86	0.99	0.76
Total	17.49	17.83	17.35	16.28

Regional Temperatures

Maximum and minimum temperatures are recorded on four Illustration Stations. The thermometers are of standard meteorological type and located four feet above the ground. The data are summarized in Table 2.

Table 2.—Average Monthly Maximum and Minimum Temperatures at Four Stations

Month	Dorintosh 3-Year Av. 1952–54 Max.	Dorintosh Min.	Loon Lake 5-Year Av. 1950–54 Max.	Loon Lake Min.	McLennan 4-Year Av. 1952–55 Max.	McLennan Min.	Snowden 11-Year Av. 1944–54 Max.	Snowden Min.
	—Degrees Fahrenheit—							
January	15.6	−19.1	− 1.8	−22.9	5	−7	5.5	−16.9
February	27.2	1.0	22.3	− 5.6	26	1	14.2	−10.8
March	31.2	3.6	28.7	1.3	31	4	27.4	− 0.8
April	49.1	18.9	46.8	22.5	46	22	45.8	20.3
May	68.1	34.4	64.4	35.1	65	37	61.7	33.9
June	71.8	42.0	70.4	40.2	70	45	69.6	42.2
July	78.0	47.6	75.7	47.6	74	48	75.7	48.5
August	75.3	46.3	71.3	43.7	73	46	72.6	46.2
September	64.5	37.9	64.6	36.3	63	36	62.6	36.8
October	55.1	26.9	51.3	25.0	54	28	50.1	26.1
November	36.3	18.4	31.2	13.3	32	13	27.5	10.6
December	22.2	4.2	17.7	− 1.9	21	0	11.7	− 9.6
AVERAGE	49.5	21.8	45.2	19.6	47	23	43.7	18.9

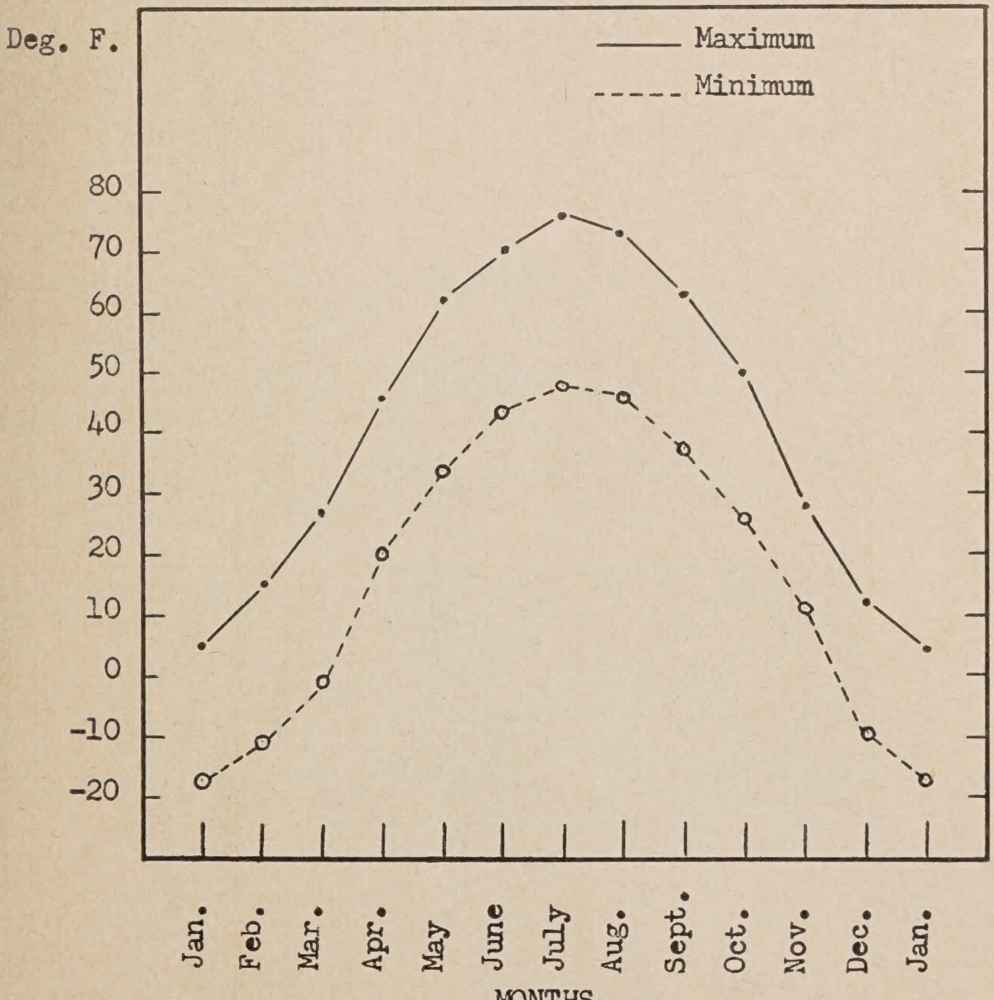

Fig. 1—Average maximum and minimum monthly temperatures for the Illustration Station at Snowden (11-year average).

The frequency of short frost-free periods in this region is of considerable importance for the selection of adaptable crops. The frost-free period varied from 108 to 124 days at Dorintosh during the 1952-54 period. At Loon Lake, the range was from 57 to 118 days for the 5-year period, 1950-54. Variation in frost-free periods at McLennan was from 61 days in 1955 to 146 days in 1952 for the 4-year period. At Snowden, the temperature was above 32° F. for 46 days in 1954 and for 115 days in 1955 representing the shortest and longest frost-free periods during the eleven years for which records were obtained.

Soil Fertility Studies

Early studies at the Chedderville and Fallis Illustration Stations in Alberta indicated that applications of nitrogen, phosphorus, and sulphur were required for crop production. The results of these early studies were reported in the Division of Illustration Stations Progress Report for 1938-1947. One of these early studies is being continued at Chedderville and the results for the years 1946 to 1955 are reported in Table 3. The data show that where sulphur was not applied the yields of clover hay within a three-year fallow—wheat—clover rotation had dropped to a low of 0.16 and a high of 0.62 tons per acre by 1955.

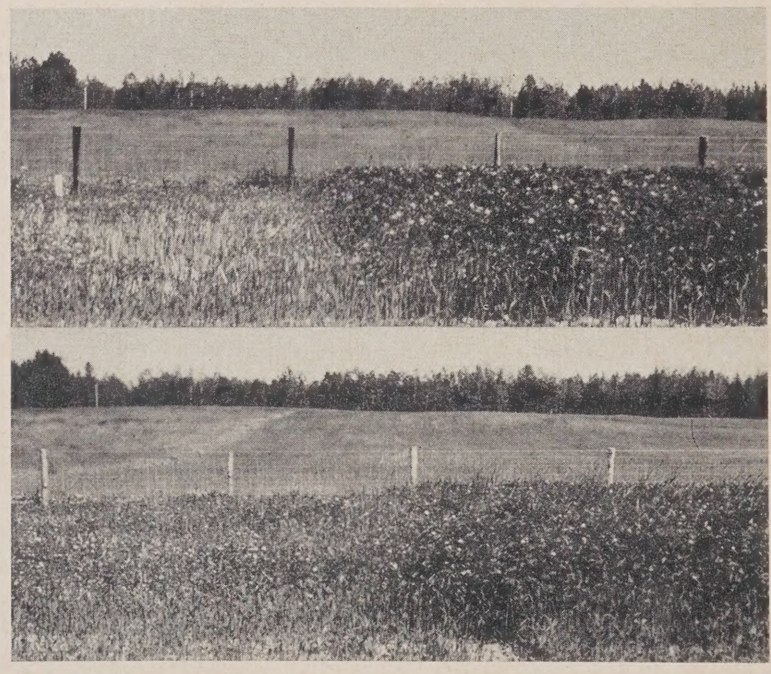

Figure 2. *Upper.*—Plant food deficiency studies with clover on sulphur-deficient gray wooded soils at Chedderville, Alta. Left: Check (No treatment). Right: Ammonium sulphate applied at 80 pounds per acre. *Lower.*—Residual effect of fertilizers on Altaswede clover grown on a sulphur-deficient gray wooded soil at Chedderville, Alberta, one year after application. Left: Ammonium phosphate (11–48–0) at 45 lb. and ammonium nitrate (33.5–0–0) at 36 lb. per acre. Right: Ammonium phosphate (16–20–0) at 100 lb. and elemental sulphur at 6 lb. per acre.

Table 3.—Effects of Fertilizers and Legume Hay Crops on Wheat Yields and the Residual Effect of Fertilizers on Succeeding Crops of Oats and Legume Hay when Grown on Caroline Loam—Chedderville, Alta.

Treatment	Rate Per Acre	Approximate Pounds of Plant Nutrients Per Acre Per Three-Year Period				Yields of Wheat After Fallow and Oats—bu./ac.		Yields of Wheat After Fallow and Legume Hay—bu./ac.		Yields of Oats After Wheat Bu./Ac.		Yields of Legume Hay After Wheat Tons/Ac.	
		N	P_2O_5	K_2O	S	1955	1946–55 10-yr. Av.	1955	1946–55 10-yr. Av.	1955	1946–55 8-yr. Av.	1955	1947–55 8-yr. Av.
Manure	15 tons					8.7	39.2	45.2	38.7	37.6	3.8	0.23	2.13
Check (Average)	—	0	0	0	0	8.9	29.3	19.4	34.3	32.2	26.8	0.19	1.18
Amm. Nitrate	50 lb.	16	0	0	0	10.2	29.7	21.4	38.8	26.9	24.8	0.17	1.24
Sulphur	20	0	0	0	20	8.9	24.9	23.4	37.9	22.8	22.7	2.01	2.52
Amm. Sulphate	80	16			20	6.9	29.9	22.8	43.7	32.7	25.7	2.08	2.55
T.S.P.	45	0	20	0	0	10.1	26.1	16.5	32.7	34.7	24.0	0.16	1.51
A.P. 11-48-0 Amm. Nitrate	45 36	16	20	0	0	9.8	33.6	28.6	36.9	61.8	31.2	0.62	1.41
A.P. 16-20-0 Sulphur	100 6	16	20	0	20	16.2	35.0	28.6	44.9	43.3	32.8	2.93	3.06
A.P. 16 20-0 Pot. Sulphate	100 40	16	20	20	20	23.0	35.0	30.9	41.9	40.2	29.1	2.42	2.76

Wherever sulphur had been applied at the rate of 20 pounds per acre per three-year period the yields exceeded 2.00 tons per acre and where the sulphur was supplemented with phosphorus, yields were further increased by about one half ton per acre, to 2.42 and 2.93 tons respectively. This study also revealed that the amount of sulphur required for wheat production is much lower than for legume production. On the basis of 10 years' results neither elemental sulphur nor ammonium sulphate have appreciably increased wheat yields in the fallow—wheat—oats rotation while they have increased the yield of legume hay 114 and 116 per cent respectively during the same period.

In this study a parallel rotation of fallow—wheat—oats was also conducted and the same treatments applied to the wheat. The comparison of the yields of the two wheat crops revealed the difficulty of maintaining cereal yields on these soils without including a legume crop in the rotation. The average yields of unfertilized wheat after fallow and oats was 8.9 bushels per acre in 1955 as compared with 19.4 bushels from unfertilized wheat after fallow and clover.

In order to assess the specific requirements of various soil types for sulphur and other nutrients four different experiments were conducted on stations especially located on named types of gray wooded soils. These were studies on (1) Single Element Deficiencies, (2) Levels of Major Nutrients, (3) Comparison of Sulphur Carriers, and (4) Comparisons of Commercial Fertilizer Formulae. In addition, work with synthetic soil conditioners was conducted on the Dorintosh loam and the Loon River loam.

Single Element Deficiencies

A study to evaluate the requirements of nitrogen, phosphorus, potassium, and sulphur was initiated at McLennan in 1947, at Loon Lake and Snowden in 1949, and at Glaslyn and Dorintosh in 1951. The treatments are shown in Table 4. The fertilizer treatments were applied to wheat on fallow and first-year legume hay in a rotation of fallow—wheat—coarse grain—hay—hay. Hence, direct effects of the treatments were measured by the yields of wheat on fallow and of first-year hay, while residual effects were indicated by the yields of coarse grain and second-year hay. Tables 5 and 6 contain summaries of the data obtained.

Table 4.—Treatment and Rate of Application, Single Element Deficiency Study

Treatment		Rate of Application per Acre				
Fertilizer Elements	Source	Fertilizer	Nutrients			
			N	P_2O_5	K_2O	S
		lb.	lb.	lb.	lb.	lb.
Check	No Fertilizer	0	0	0	0	0
N	Ammonium Nitrate	50	16	0	0	0
S	Sulphur	20	0	0	0	20
NS	Ammonium Sulphate	80	16	0	0	20
P	Triple Superphosphate	45	0	20	0	0
NP	Ammonium Phosphate 11-48-0 + Ammonium Nitrate	45 + 36	16	20	0	0
NPS	Ammonium Phosphate 16-20-0 + Sulphur	100 + 6	16	20	0	20
NPKS	Ammonium Phosphate 16-20-0 + Potassium Sulphate	100 + 40	16	20	20	20

The most spectacular response from the application of sulphur to a legume forage crop was obtained on the Loon River soil. Sulphur applied in the sulphate form at the rate of 20 pounds per acre alone or in combination with nitrogen

and phosphorus more than doubled hay yields. In some years the alfalfa crop growth in the absence of sulphur was so poor that there was little to harvest. Such was the case in 1954 with second-year hay at Loon Lake when the alfalfa plants in the untreated plots were unable to compete with dandelion growth.

Table 5.—The Effect of Direct Fertilizer Application on Wheat and Hay Yields per Acre

Fertilizer Elements	Wheat on Fallow					First-Year Hay		
	McLennan 1947–51	Dorintosh 1951–54	Glaslyn 1951–54	Loon Lake 1951–54	Snowden 1949–54	Dorintosh Alfalfa 1953	Glaslyn Sweet Clover 1953	Loon Lake Alfalfa 1953
	bu.	bu.	bu.	bu.	bu.	tons	tons	tons
No Fertilizer	14.7	25.3	32.7	25.0	26.8	1.62	1.35	1.39
N	15.1	26.9	33.1	24.7	27.9	1.82	1.73	0.87
S	14.0	26.0	32.9	30.0	27.3	2.08	1.95	2.44
NS	14.1	27.4	31.9	34.6	28.9	1.75	1.46	3.34
P	18.4	30.0	38.4	28.2	34.2	1.97	1.59	1.28
NP	20.5	30.3	40.1	32.5	35.9	1.83	1.75	1.57
NPS	19.9	28.5	40.8	34.5	37.5	1.86	1.63	3.42
NPKS	20.4	29.3	39.8	33.1	36.2	2.03	1.76	2.75

Table 6.—The Residual Effect of Fertilizer Application on Grain and Hay Yields per Acre

Fertilizer Elements	Coarse Grains Following Fertilized Wheat			Second-Year Hay	
	Glaslyn Barley 1952–53	Loon Lake Oats 1953–54	Snowden Oats 1954	Dorintosh Alfalfa 1954	Loon Lake Alfalfa 1954
	bu.	bu.	bu.	tons	tons
No Fertilizer	32.8	29.8	55.1	2.42	2.43
N	30.2	23.4	51.9	2.47	2.08
S	29.9	34.0	55.1	2.62	3.30
NS	31.5	34.0	54.0	3.18	3.66
P	33.2	30.8	47.1	3.28	1.74
NP	31.8	25.0	48.9	3.32	1.69
NPS	29.2	33.4	56.9	4.33	3.20
NPKS	34.2	42.1	52.1	4.37	3.93

For wheat on summerfallow, nitrogen alone had no effect at any location. Sulphur alone increased the yield by 20 per cent at Loon Lake. Phosphorus alone increased the yield of wheat at all stations, the amount varying from 12.8 per cent at Loon Lake to 27.6 per cent at Snowden. At all stations, phosphorus hastened maturity.

The application of phosphorus and nitrogen on the hay did not significantly increase the yield of forage the first year but phosphorus had a residual effect at Dorintosh. Generally, however, there was little if any carry-over of the effects from nitrogen and phosphorus on any of the soil types from the original year of application.

Interaction effects were noted between N + P and N + S. The nitrogen plus phosphorus combination increased the yield of wheat on fallow and first-year hay at all stations. At Loon Lake, the nitrogen and sulphur combination also gave yield increases. The increase for wheat on fallow was greater from combinations of nutrients than those obtained from applying nitrogen, phosphorus, or sulphur singly.

Levels of Major Nutrients

In this study, nitrogen, phosphorus, and potassium were applied at two levels each, with and without sulphur to cereals and forages on three soil types: Nampa at McLennan, Loon River at Loon Lake, and Garrick at Snowden. Rates of application of N, P_2O_5 and K_2O were 8 and 16; 20 and 40; and 0 and 20 pounds per acre, respectively. Gypsum was applied at 100 pounds per acre to supply approximately 20 pounds of elemental sulphur.

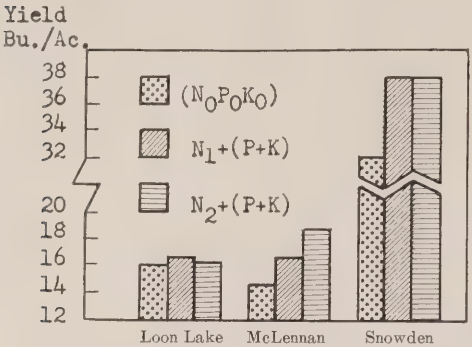

Fig. 3—Effect of two levels of nitrogen on wheat, at 8 and 16 pounds per acre, with P_2O_5 and K_2O.

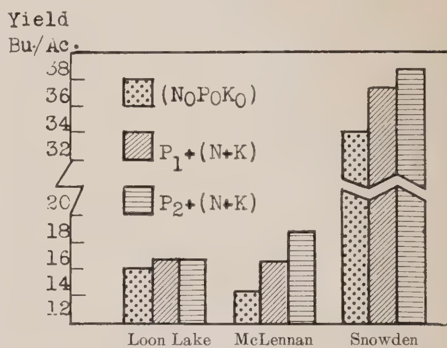

Fig. 4—Effect of two levels of P_2O_5 on wheat, at 10 and 20 pounds per acre, with N and K_2O.

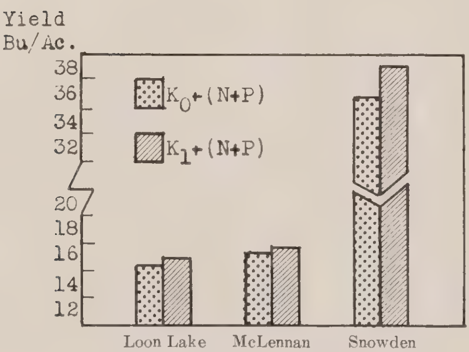

Fig. 5—Effect of K_2O on wheat, with N and P_2O_5.

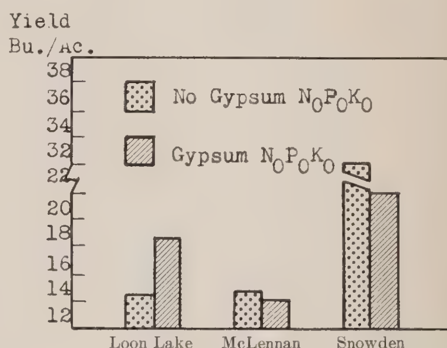

Fig. 6—Fffect of gypsum on wheat.

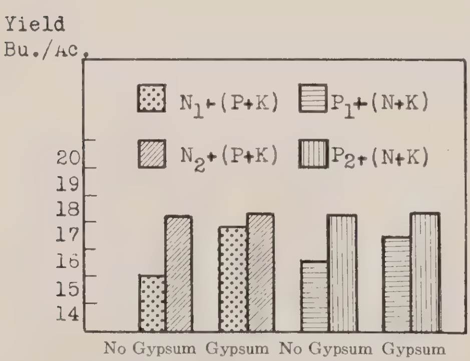

Fig. 7—Effect of gypsum + treatment on whеat, McLennan.

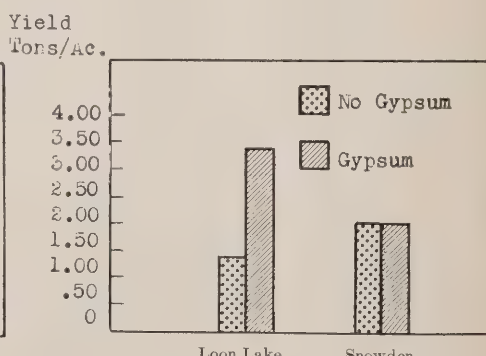

Fig. 8—Residual effect of gypsum on second-year hay at two locations.

Table 7.—Effect of Sulphur Carriers on Yield Per Acre of Cereals and Legumes, Loon Lake, Dorintosh, and Athabaska

Treatments	Loon Lake			Dorintosh	Athabasca	
	Wheat on Fallow (Initial Application)	Oats After Wheat (Residual Effect)	Second-year Alfalfa (Repeat Application)	Wheat on Fallow (Initial Application)	Oats on Breaking (Initial Application)	First-year Brome-Alfalfa (Repeat Application)
	1951-54	1952-54	1953-54	1953-54	1953	1955
	bu.	bu.	Tons of hay	bu.	bu.	Tons of hay
No Fertilizer	23.1	41.2	1.46	20.4	55.6	0.89
N + P + K	25.7	39.7	1.94	27.2	68.7	1.07
N + P + K + Sulphur	25.6	49.3	2.61	26.1	69.3	1.17
N + P + K + Gypsum	33.4	47.3	2.31	24.8	74.8	2.38
N + P + K + Sodium Sulphate	29.4	42.6	2.02	25.4	77.4	2.51
N + P + K + Ammonium Sulphate	31.0	48.7	2.65	25.1	76.0	2.53
N + P + K + Potassium Sulphate	28.1	46.4	2.59	24.6	76.6	2.47
A.P. 16-20-0 + Potash	27.4	47.7	2.13	23.0	76.1	2.52

Note: Crops were grown in rotation and initial applications of treatments were made to the first cereal crops and repeat applications were made to hay the year after seeding.

The effect of the four elements to wheat on fallow was measured in 1949, 1950, and 1954 at Loon Lake, 1950 to 1952 at McLennan, and 1949 to 1954 at Snowden. Figures 3 to 8 illustrate graphically the salient results of this phase of the experimental work.

At Loon Lake, response was obtained from the application of gypsum. No major yield differences can be attributed to any particular combination of the other three elements although there was some indication of a P + K interaction. The higher level of nitrogen and phosphorus at McLennan and of phosphorus and potassium at Snowden, significantly increased the yield of wheat over the lower rate of each applied. There was no significant effect from gypsum at either station, although at McLennan the gypsum + treatment interaction was significant. Here, the higher level of nitrogen had a greater effect without gypsum than with gypsum. Similarly, the high level of phosphorus had a greater effect without gypsum than with gypsum. The residual effect on the succeeding grain crops was negligible in all tests. There was a striking difference between results at Loon Lake and Snowden when sulphur was applied on first-year alfalfa. At Loon Lake the yield was nearly tripled whereas at Snowden the effect was negligible.

Comparison of Sulphur Carriers

A test was conducted at Loon Lake, Dorintosh, and Athabasca to compare the effect of six different sulphur carriers on cereal and forage crops. The compounds were applied at rates sufficient to supply 20 pounds of sulphur per acre. To balance the other plant nutrients, ammonium nitrate, triple superphosphate and muriate of potash were applied to provide 23 pounds of nitrogen, 28 pounds of phosphate, and 56 pounds of potash per acre. The results from these tests are presented in Table 7.

All the sulphur carriers increased the growth of cereal and forage crops on Loon River soil. With cereals, the sulphate compounds tended to be more effective than elemental sulphur in the first year of application but in the second year and repeat applications all forms were about equally effective. On the Dorintosh soil type, sulphur did not appear necessary for grain production. At Athabasca the sulphate forms of sulphur were much more effective than elemental sulphur.

Comparison of Commercial Fertilizer Formulae

The following commercial fertilizer formulations were tested at three stations on cereal crops: ammonium phosphate (11-48-0 and 16-20-0), triple superphosphate (0-43-0), and ammonium nitrate (33.5-0-0). The rates used and the data obtained from this test are presented in Table 8.

Yield increases were obtained from the application of ammonium phosphate (A.P.) fertilizers at all the stations. At Glaslyn and McLennan, the 50-pound rate of 11-48-0 increased the yields significantly over the 40-pound rate but not at Snowden. The ammonium phosphate formulations, particularly 11-48-0 were more effective in increasing the yield at an equivalent rate of P_2O_5 per acre than the triple superphosphate (T.S.P.) formulation. On the three stations, triple superphosphate (0-43-0) at 20 pounds per acre of P_2O_5 increased the yields by 7.0, 7.3, and 3.2 bushels per acre, the 11-48-0 by 8.4, 10.0, and 3.2 bushels, and the 16-20-0 by 8.2, 7.4, and 4.2 bushels respectively. Nitrogen when applied alone was not effective in increasing the yields.

Table 8.—Yield Response of Wheat on Fallow to Commercial Fertilizer

Treatment		[1]Nutrients Applied per Acre		Yields per Acre (4-year average, 1951–54)		
Formulae	Rate per acre	N	P_2O_5	Glaslyn	McLennan	Snowden
	lb.	lb.	lb.	bu.	bu.	bu.
No Fertilizer	0	0	0	31.2	32.3	26.7
				Increases from fertilizers		
Triple Superphosphate	25	0	10	4.9	4.3	0.5
Triple Superphosphate	50	0	20	7.0	7.3	3.2
Triple Superphosphate	75	0	30	—	9.2	—
Triple Superphosphate	125	0	50	—	9.8	—
A.P. 11-48-0	20	2	10	5.3	4.9	2.1
A.P. 11-48-0	40	4	20	8.4	10.0	3.2
A.P. 11-48-0	50	6	24	9.7	14.7	3.7
A.P. 16-20-0	48	8	10	4.2	4.3	3.3
A.P. 16-20-0	96	15	20	8.2	7.4	4.2
Ammonium Nitrate	29	10	0	—	0.1	—
Ammonium Nitrate	58	19	0	—	−0.6	—

[1]The percentage composition of commercial materials varies and the quantities given are approximate.

Soil Conditioners

Investigations with synthetic soil conditioners were commenced at Loon Lake in 1952. On one area, a conditioner was applied at 500 pounds per acre and worked to a depth of three inches. Carrots and radishes were then seeded. On a second area ,1,000 pounds was applied to a depth of six inches and wheat was seeded. A conditioner was also applied at 2,000 pounds per acre at Dorintosh with oats and alfalfa being sown. Ammonium phosphate (11-48-0) fertilizer at 40 pounds per acre was applied to one-half of the plot. In these preliminary tests, the yield of the vegetable and grain crops was definitely increased. The application of 500 pounds per acre gave a marked increase in yield of carrots and radishes.

Observations throughout the summer indicated that emergence was hastened and the surface soil structure improved. The application of 1,000 pounds increased the yield of wheat over the non-treated area. The effect of the application of 2,000 pounds per acre on the yield of oats was greater with the addition of an application of fertilizer than without.

In 1953 more detailed work was initiated at Loon Lake. Soil conditioners were applied at three rates, singly and in combination with manure, straw, and ammonium phosphate fertilizer. The area was fallowed in 1952 prior to the broadcast application in 1953 which was worked to a six-inch depth.

While there was apparently quite large yield response to applied soil conditioners the results were not statistically significant. The variability of the data was very high as indicated by a large coefficient of variability.

Crop Adaptation and Seeding Management

Cereal Crop Yields on Fallow as affected by Seeding Rates and Fertilizers.

At Snowden, a test was started in 1948 to evaluate the relative productivity of wheat, oats and barley when seeded with and without a commercial fertilizer, each at two rates of seeding. The test was conducted with the currently recommended cereal variety. The fertilizer was ammonium phosphate 11-48-0 at 30 pounds per acre. The results obtained are illustrated in Figure 9.

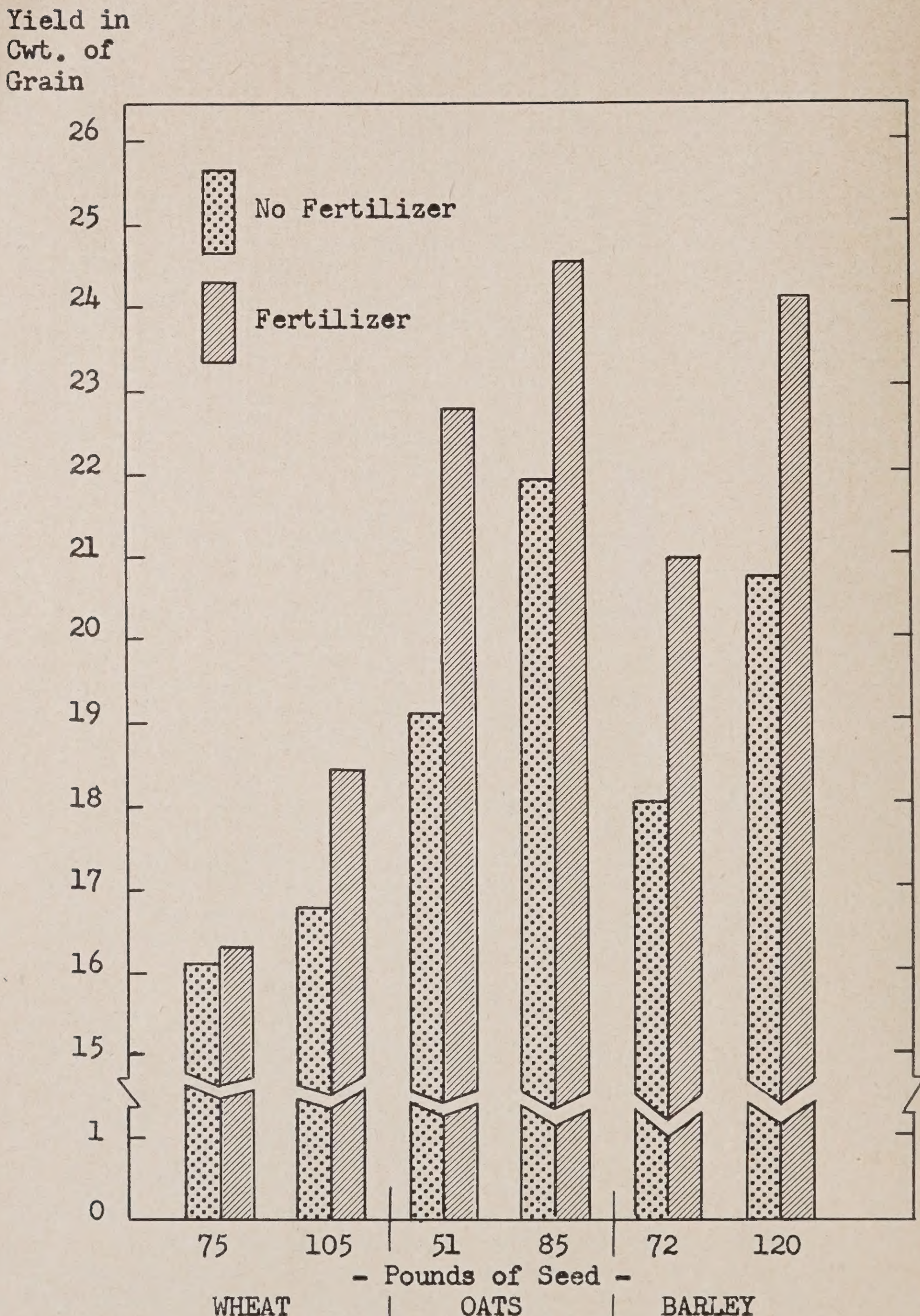

Fig. 9.—Cereal crop yields per acre as affected by seeding rates and fertilizer.

The yields obtained in pounds of grain per acre were greater from oats than from barley which in turn were higher than from wheat. The yields for all crops were greater from the higher rate of seeding than from the lower rate.

Fertilizer increased the yield for the lower and higher rates of seeding by 0.3 bushels and 2.8 bushels of wheat, 10.6 and 7.7 bushels of oats, and 6.2 and 6.9 bushels of barley, respectively.

When the rate of seeding of wheat was increased from 75 pounds to 105 pounds per acre with fertilizer the yield was increased from 27.1 to 30.7 bushels per acre. Increasing the rate of seeding oats from 51 pounds per acre to 85 pounds with fertilizer increased the yield from 66.9 to 72.1 bushels per acre. The yield of barley was increased from 43.7 to 50.1 bushels per acre with a seeding rate of 120 pounds per acre as compared with the 72-pound rate, both with fertilizer.

Summary

1. The response of cereal and forage crops to the application of sulphur varied greatly between different regions within the Gray Wooded soil zone. At Loon Lake, Chedderville, and Athabasca the response was very pronounced, whereas, at McLennan, Dorintosh, Glaslyn, and Snowden it was negligible.

2. Nitrogen applied alone to legumes and to grain on fallow gave very little response in yield.

3. Phosphorus, particularly when applied with nitrogen to fallow grain, gave very impressive yield increases. Phosphorus occasionally gave slight residual effects on legumes at Loon Lake and Dorintosh.

4. Potassium did not increase yields of grain or legumes when applied alone but with nitrogen and phosphorus it increased grain yields somewhat at Snowden and McLennan.

5. Manure alone increased the yield of legumes and grain at Snowden.

6. The results obtained to date with soil conditioners are inconclusive.

7. In a seeding management study on fallow land at Snowden, oats outyielded barley which in turn outyielded wheat. Decreasing the seeding rate reduced the yield.

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